layers. The N- layer in Beasom '153 is a very low dopant layer therefore having the N- notation. The P region 36 in Beasom '153 is a generally medium dopant region compared to the N+ region 34. Region 34 is the only highly dopant buried region in Beasom '153 which has no contact with the upper surface.

To avoid any confusion applicant has amended the claims to indicate that the buried regions are specifically N+ and P+ and therefore a highly dopant region as compared to the remaining layers and regions formed therein to constitute the active devices. It should be noted that it is well known in the art of semi-conductor fabrication that a "buried" layer process includes a heavily dopant N+ type region. Attached is a treatise of Integrated Circuits, Designed Principles and Fabrication (c)1965 p.189 to associating the meaning of the term "buried" and N+ layer.

Thus the Beasom U.S. Patent 5,652,153 does not anticipate the limitation of claim 1, since it does not have a unselective N+ buried layer and it does not have a selectively formed P+ buried layer. Nor would it be obvious to modify it with Parker et al. nor Pendharkar et al. The other independent claims and the dependent claims are allowable for the same reason as well as their additional limitations.

It should be noted that claim 18 is not rejected in the body of the office action.

Upon review of the above arguments it will be evident that the present application that claims 1-39 and 57-64 are allowable over the art of record.

The non-elected claims have been cancelled with no intent to abandon, it will be the subject of future applications. The present application is considered in condition for allowance and thus passage to issue is hereby requested. A favorable examination of the subject application is hereby requested.

Respectfully submitted,

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Enclosure

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Design Principles and Fabrication

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If a higher level of current operation is required, then by scaling up the geometry to a 1- by 6-mil structure, for example, the series resistance can be reduced even further. For an emitter length of 6 mils,

$$\bar{l} = \tfrac{1}{2}(l_E + l_C) = \tfrac{1}{2}(6 + 9) = 7.5 \text{ mils} \tag{7-28}$$

and

$$r_{SC} \approx \frac{0.1 \text{ ohm cm} \times 2 \text{ mils}}{2 \times 7.5 \text{ mils} \times 22 \times 10^{-4} \text{ cm}} = 6 \text{ ohms} \tag{7-29}$$

Thus, the scaling up of the geometry reduces the series resistance from about 15 to 6 ohms.

If we saturate the gold-doped transistor at a collector current level of 20 mA and an I_C/I_B ratio of 10, then we obtain the same junction potential V_{CE} as given by Eq. (7-27). The series voltage drop at 20 mA through 6 ohms would equal 0.12 volt. Therefore, the total $V_{CE(SAT)}$ for the 1- by 6-mil gold-doped monolithic transistor at 20 mA is 0.31 volt.

One useful method of reducing the collector series resistance of a monolithic transistor is illustrated in Fig. 7-10. This is the so-called "buried" layer process by

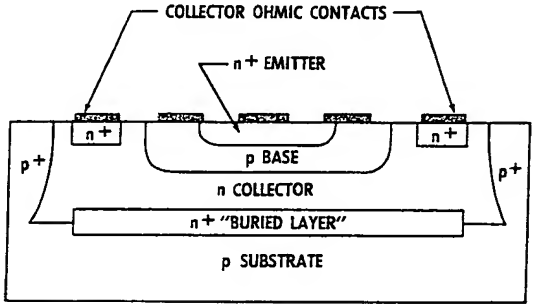

Fig. 7-10 Use of a "buried" n^+ layer to reduce collector series resistance.

which a heavily doped n^+-type region is sandwiched between the n-type epitaxial collector and the p-type substrate. This buried n^+ region has the effect of shunting the high-resistivity collector region, thereby reducing the series resistance considerably. There are two basic methods of achieving this particular structure, namely, (1) by diffusing the n^+ layer into the p-type substrate before the growth of the n-type epitaxial collector, and (2) by selectively growing the n^+ regions, using masked epitaxial techniques, and then continuing on by growing the n-type collectors epitaxially. This technique results in nearly an order of magnitude reduction in r_{SC}. The striking advantage of the buried layer structure is that for saturated switching transistors we can now design on the basis of higher resistivities for the collector region, in order to reduce capacitance and still obtain very low r_{SC}.

7-7 Frequency Response of Monolithic Transistors

The frequency response of a monolithic transistor is best characterized by the parameter f_T, which is that frequency at which the magnitude of β is equal to unity